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## Coordinated public health actions following the identification of a measles case arriving on an international flight, Spain: December 2022–January 2023

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### ABSTRACT

Contact tracing of individual exposed to any infectious measles case deserves special attention when in the country the disease is mostly imported. We present the coordinated public health actions triggered after reporting a suspected measles case in an aircraft. Spanish public health authorities and airlines responded promptly to allow a rapid contact tracing. Even one secondary measles case was reported no further transmission was identified, revealing that giving PEP and appropriate information help to avoid transmission and to maintain measles elimination in Spain.

### 1. Introduction

Measles is a highly contagious disease that can be prevented by vaccination. The ambitious elimination goal planned by the World

Health Organization (WHO) for the end of the 20th century [1] had to be revised and updated due to changing global circumstances [2].

Since the beginning of 2022, the reporting of measles cases and outbreaks has increased globally [3], potentially due to the impact of the

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COVID-19 pandemic on vaccination programmes [4] and the waning of protective measures after the acute phase of the pandemic.

Although Spain achieved measles elimination status in 2017, some Autonomous Regions have reported imported measles cases in recent years, sometimes resulting in limited outbreaks [5,6].

In this context of challenges regarding the sustainability of elimination status, we present the coordinated actions to limit transmission following the identification of a confirmed measles case in a citizen flying to Spain.

## 2. Index case

On December 21, 2022, the Regional Public Health Authority (RPHA) of Balearic Islands notified the Coordinating Centre for Health Alerts and Emergencies (CCAES) of the Ministry of Health (MoH) about a suspected measles case in an adult arriving from India by plane. The passenger had travelled on two international flights-from Goa (India) to Qatar (flight 1) and from Qatar to Barcelona (Catalonia) (flight 2)-and then, on a domestic flight from Barcelona to Ibiza (Balearic Islands) (flight 3).

The rash onset on December 18, 2022, coincided with the date of flights. The case was a 42-year-old man without history of measles vaccination (Case 1), who was hospitalized the same day with classic measles symptoms (rash, fever, cough, coryza and conjunctivitis).

On December 22, 2022, laboratory results at the regional level showed positive IgM and negative IgG measles antibodies. On December 28, 2022, the measles virus (MeV) was detected by RT-PCR in both throat swab and urine samples, by the National Reference Laboratory at the National Centre for Microbiology (Instituto de Salud Carlos III), showing an identical N450 sequence to MVs/Victoria.AUS/6.11[D8] variant. This variant was circulating in India prior to the rash onset according to the Measles Nucleotide Surveillance (MeaNS) database (Table 1).

## 3. Contact tracing management and actions

According to Spanish guidelines and the Risk Assessment Guidance for Diseases Transmitted on Aircraft (RAGIDA) of the European Center for Disease Prevention and Control (ECDC) [7,8] contact tracing is strongly recommended if the index case is probable or laboratory confirmed, the case had travelled while infectious (4 days prior to 4 days after the rash onset), and the flight occurred within the previous 5 days. These criteria were met, triggering a set of actions at the national level (Fig. 1).

In Spain, the responsibility for requesting passenger information from airlines depends on whether the flight is international or domestic. For international flights, this duty corresponds to the Foreign Health department at the MoH, and for domestic flights, it falls to the RPHAs [9].

For **flight 1**, the MoH under the framework of the International Health Regulations (IHR) notified this case via an email to the National Focal Points (NFPs) of Qatar and India so that public health measures could be initiated according to their national guidelines.

For **flight 2**, which landed in Spain, the General Subdirectorate for

Foreign Health at the MoH contacted the airline requesting information about all passengers on the flight. Of the 300 passengers identified, 223 resided in 37 different countries. Details of passengers with residences outside Spain were shared using the Early Warning Response System (EWRS) platform for the European Union and the European Economic Area countries (EU/EEA) and via email to the IHR NFPs for non-EU/EEA countries. The remaining 77 passengers were classified according to their region of residence in Spain, and passenger details (name, postal address, telephone and email) were completed with the help of the National Police Service (Fig. 1). Nine RPHAs were also informed and asked to initiate contact tracing.

For **flight 3**, since it was a domestic flight, the Balearic Islands RPHA was responsible for contact tracing of all 130 passengers. The airline provided only the names and email address of the passengers.

Between December 22 and 24, nine RPHAs advised and recommended post-exposure prophylaxis (PEP) to passengers residing in Spain. Passengers of the domestic flight were contacted by email (Fig. 1).

On January 20, 2023, following an incubation period after exposure to the measles case on the aircraft, the National Centre for Epidemiology (Instituto de Salud Carlos III) sent a survey to the nine involved RPHAs. The survey gathered information on specific actions related to contact tracing activities and vaccination recommendations that had been carried out in each region [8] (Table 1).

Fifty-eight passengers did not require any intervention because they had received two doses of the measles vaccine, had had natural measles, or belonged to a birth cohort in which measles is assumed to have occurred [7]. Ten of the 11 people recommended for MMR vaccination were vaccinated. For seven passengers, a recommendation of human normal immunoglobulin (HNIG) was made following national measles control guidelines [10]. Five passengers received it, while two refused or did not attend the appointment (Fig. 2). One case could not be contacted. Neither quarantine nor movement restrictions were recommended; instead, advice was given on recognizing symptoms and early communication with health centres.

The 130 passengers of flight 3 were informed by email on December 23–24. Only one passenger contacted health services, and HNIG was recommended and administered.

## 4. Reporting possible secondary cases

On January 4, 2023, the Region of Catalonia, reported to the National Epidemiological Surveillance Network (RENAVE) a confirmed measles case [10] in an individual seated three rows apart from the index case on flight 2. An unvaccinated 24-year-old person, reluctant to receive PEP, presented with a rash on January 2, 2023, 15 days after sharing the flight with the index case (Case 2). MeV was detected by RT-PCR in urine and nasopharyngeal swab. Molecular analysis revealed the same variant of MeV as identified in the index case (Table 2). In addition to isolating the secondary case during the infectious period, contact tracing was setup among household and friend contacts. No further transmission was reported (Fig. 2).

On January 10, 2023, the Balearic Island reported to the RENAVE a suspected case in a passenger who had travelled on flight 3 with the index case. The case was an adult with an unknown vaccination history

**Table 1**

Laboratory study of suffered from measles suspected cases related to an international flight arriving to Spain: December 2022–January 2023.

	Date of onset	IgM	IgG	IgG Avidity	RT-PCR	MVs N450-variant or "named strain"	GenBank Accession Number	Final Classification
<b>Case 1</b>	18 December 2022	Positive	Negative	NA	Positive <sup>a</sup>	MVs/Victoria.AUS/6.11 [D8]	KF469368	Confirmed [Index case]
<b>Case 2</b>	January 2, 2023	-	-	-	Positive <sup>a</sup>	MVs/Victoria.AUS/6.11 [D8]	KF469368	Confirmed. [Secondary case]
<b>Case 3</b>	January 4, 2023	Negative	Positive	High	Negative <sup>b</sup>	NA	NA	Discarded

<sup>a</sup> Determination on throat swab and urine.

<sup>b</sup> PCR negative for measles, rubella and Parvovirus B19.

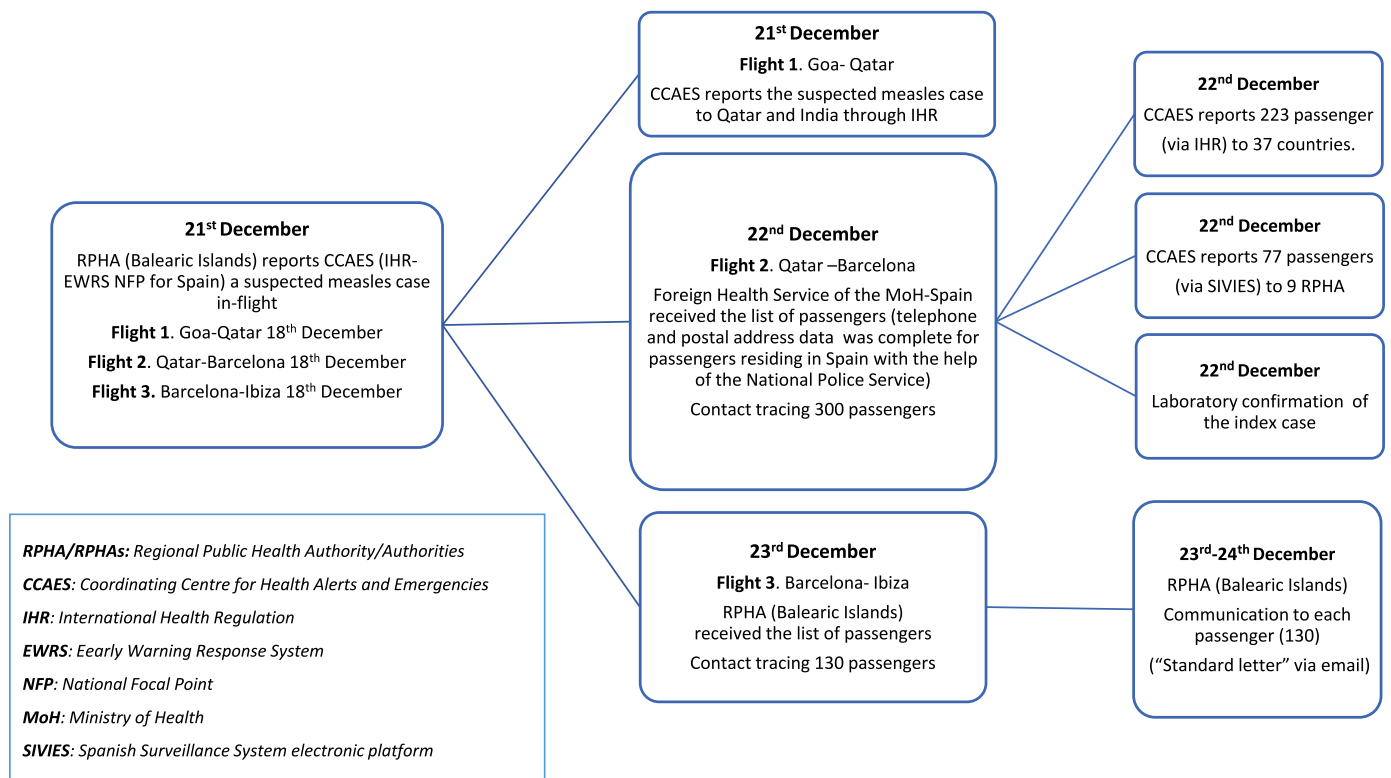


Fig. 1. Flow diagram of actions implemented responding to the reporting of a suspected measles case on an international flight. Spain, December 2022.

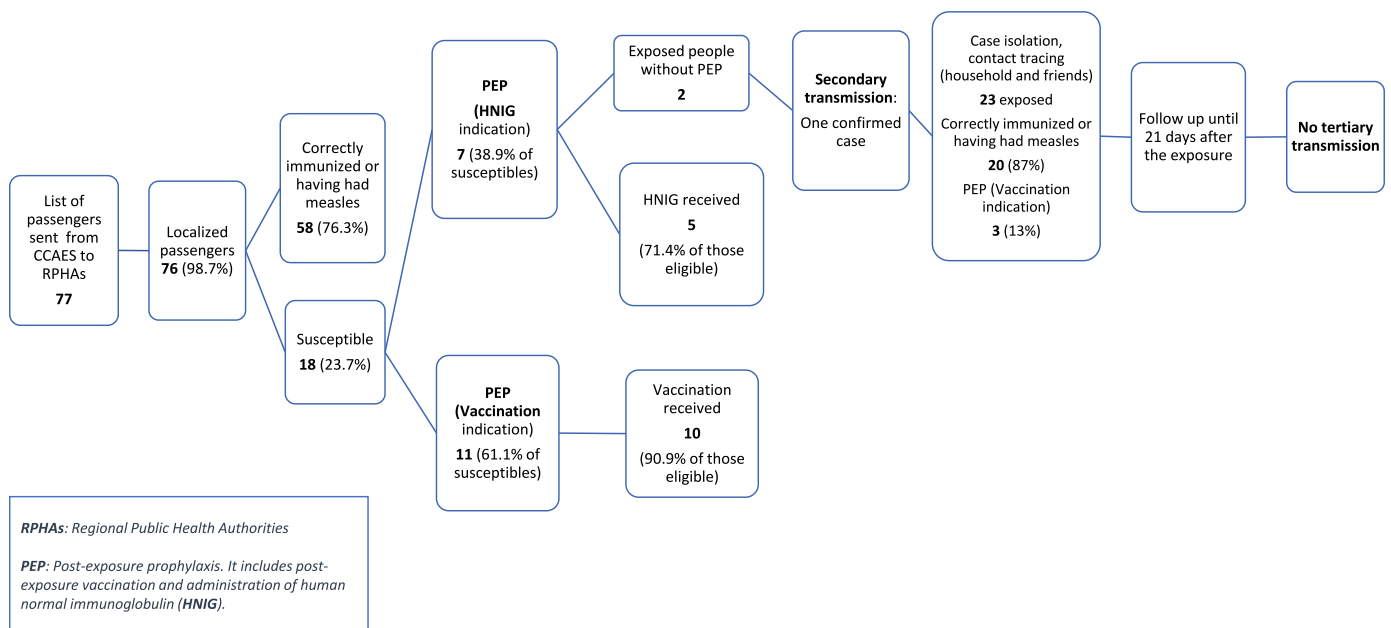


Fig. 2. Measles control and preventive activities carried out on exposed passengers on an international flight. Spain, December 2022–January 2023.

who started with fever and rash on January 4. After laboratory investigation, the case was discarded for measles (Case 3) (Table 2).

### 5. Discussion

The most effective way to sustain measles elimination is by maintaining high vaccination coverage with two doses of the measles vaccine. Moreover, enhanced surveillance to identify any circulation of measles and a prompt response to outbreaks to interrupt any

transmission of virus are crucial. In Spain, a country where measles cases are mostly imported, contact tracing of individuals exposed to any infectious measles case is essential to maintain elimination status. Combining epidemiological and molecular information is key to documenting the absence of measles transmission [7,8].

In this post-elimination phase, the role of travellers on international flights should be given special consideration because of their role in the importation of measles and the subsequent secondary outbreaks [11]. Both national and international legislation, as well as agreements with

**Table 2**

Survey to collect information on actions taken following contact notification of a measles case in a means of transport.

1.	How many passengers exposed on the means of transport are residents in the autonomous community?
2.	How many passengers have been traced?
3.	How many passengers have not needed intervention because they were properly immunised or suffered measles?
4.	How many passengers have been advised to be vaccinated?
5.	How many passengers have been vaccinated?
6.	How many passengers have been prescribed human normal immunoglobulin (HNIG)?
7.	How many people have been given HNIG?
8.	Has any measles IgG serology been performed?
9.	Have the names of exposed passengers been transferred to the corresponding local public health service?
10.	Has any quarantine been indicated?
11.	How have you contacted passengers? Only by phone/only by email/both
12.	Have passengers been advised to notify the health system if symptoms appear?
13.	Have they been told how to contact the health system in case of symptoms?
14.	Have secondary cases of measles been reported?
15.	Other comments

This survey was sent to the 9 Regional Public Health Authorities (RPHA) involved in the management of the contacts of a measles case identified in an international flight and in a domestic flight.

airlines to provide passenger data in a timely manner [12,13] should be put in place to avoid delays in contact tracing and the timely administration of PEP [13].

There is some debate about the usefulness of performing contact tracing in situations described above [12,14], given the significant time and resources required in contact tracing of passengers exposed to measles on a flight. However, our experience shows the usefulness of establishing contact tracing in an elimination context if the criteria are met [7,8]. In each specific situation, a rapid risk assessment (RRA) should be carried out to determine whether to initiate contact tracing activities [8,14].

## 6. Conclusions

The coordinated and timely response from national, regional and local public health authorities, along with civil aviation companies and the National Police Service, following the identification of a measles case travelling by aircraft, is essential to limit measles transmission in an elimination setting such as Spain.

Contact details of passengers, such as the place of residence and phone number, allowed the rapid management of exposed individuals by local public health teams. This information facilitated access to electronic vaccination or other health registries and allowed immediate contact with passengers for the timely indication and administration of PEP. Providing health advice to exposed contacts helped to prevent transmission and maintain measles elimination in the country.

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## CRediT authorship contribution statement

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## References

- [1] Ramsay, Mary & World Health Organization. Regional Office for Europe. (1999). A strategic framework for the elimination of measles in the European Region by Mary Ramsay, February 1997. Copenhagen : WHO Regional Office for Europe. <https://iris.who.int/handle/10665/108278>.
- [2] Measles outbreaks strategic response plan 2021–2023. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO, <https://iris.who.int/bitstream/handle/10665/340657/9789240018600-eng.pdf?sequence=1&isAllowed=y>.
- [3] Provisional measles and rubella data [Accessed January 2023] reports measles and rubella cases and incidence rates by WHO Member States (Excel) [Internet]. Available in: <https://immunizationdata.who.int/global?topic=Provisional-measles-and-rubella-data&location=>.
- [4] Rachlin A, Danovaro-Holliday MC, Murphy P, Sodha SV, Wallace AS. Routine vaccination coverage - worldwide, 2021. *MMWR Morb Mortal Wkly Rep* 2022 Nov 4;71(44):1396–400. <https://doi.org/10.15585/mmwr.mm7144a2>.
- [5] Pampaka D, López-Perea N, Fernández-García A, Huertas-Zarco I, Castellanos-Martínez M, Villatoro-Bongiorno K, Roig-Sena J, Torner N, Mar Mosquera M, Echevarría JE, Ferras Prats J, Masa-Calles J. An interregional measles outbreak in Spain with nosocomial transmission, November 2017 to July 2018. *Euro Surveill* 2023;28(17). <https://doi.org/10.2807/1560-7917.ES.2023.28.17.2200634>. pii=2200634.
- [6] Centro Nacional de Epidemiología (CNE). Centro Nacional de Microbiología (CNM). Instituto de Salud Carlos III (ISCIH), CIBERESP. Plan Nacional de Eliminación del Sarampión y de la Rubeola. Informe anual 2019. Madrid, España. Available in: [https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Documents/archivos.20A-Z/Sarampi.C3.B3n/Informe\\_anual\\_SAR\\_RUB\\_2019\\_VF\\_Rev.pdf](https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Documents/archivos.20A-Z/Sarampi.C3.B3n/Informe_anual_SAR_RUB_2019_VF_Rev.pdf).
- [7] Consejo Interterritorial del Sistema Nacional de Salud, de Sanidad Ministerio. Plan estratégico para la eliminación del sarampión y la rubeola en España [Internet], [https://www.sanidad.gob.es/areas/promocionPrevencion/vacunaciones/sarampion-rubeola/docs/PlanEstrategico\\_SarampionyRubeola.pdf](https://www.sanidad.gob.es/areas/promocionPrevencion/vacunaciones/sarampion-rubeola/docs/PlanEstrategico_SarampionyRubeola.pdf); 2021.
- [8] European Centre for Disease Prevention and Control, Risk assessment guidelines for diseases transmitted on aircraft (RAGIDA). Part 2, Operational guidelines for assisting in the evaluation of risk for transmission by disease. European Centre for Disease Prevention and Control; 2010. <https://data.europa.eu/doi/10.2900/37002>.
- [9] Ley 33/2011, de 4 de octubre, General de Salud Pública. [Internet]. «BOE» núm. 240, de 05/10/2011; 2011. Available in: BOE-A-2011-15623 <https://www.boe.es/eli/es/l/2011/10/04/33>.
- [10] Centro Nacional de Epidemiología. Instituto de Salud Carlos III. Red Nacional de Vigilancia Epidemiológica. Protocolos de enfermedades de declaración obligatoria. 2013 [Internet], [https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Documents/PROTOCOLOS/PROTOCOLOS.20EN.20BLOQUE/PROTOCOLOS\\_RENAVE-ciber.pdf](https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Documents/PROTOCOLOS/PROTOCOLOS.20EN.20BLOQUE/PROTOCOLOS_RENAVE-ciber.pdf).
- [11] Angelo KM, Gastañaduy PA, Walker AT, Patel M, Reef S, Lee CV, et al. Spread of measles in Europe and implications for US travelers. *Pediatrics*. Julio de 2019;144(1). <https://doi.org/10.1542/peds.2019-0414>.

- [12] Public Health England. Measles: Guidance on international travel and travel by air [Internet], [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/842319/Measles\\_guidance\\_for\\_health\\_protection\\_staff\\_on\\_international\\_travel\\_and\\_travel\\_by\\_air.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/842319/Measles_guidance_for_health_protection_staff_on_international_travel_and_travel_by_air.pdf); 2019.
- [13] Thole S, Kalhoefer D, An der Heiden M, Nordmann D, Daniels-Haardt I, Jurke A. Contact tracing following measles exposure on three international flights, Germany, 2017. *Euro Surveill* 2019 May;24(19):1800500. <https://doi.org/10.2807/1560-7917.ES.2019.24.19.1800500>.
- [14] Lim LL, Ho SA, O'Reilly M. In-flight transmission of measles: time to update the guidelines? *Am J Infect Control* 2016 Aug 1;44(8):958–9. <https://doi.org/10.1016/j.ajic.2016.02.010>.